



Europäisches  
Patentamt  
European  
Patent Office  
Office européen  
des brevets



(11)

EP 3 777 693 A1

(12)

## EUROPEAN PATENT APPLICATION

(43) Date of publication:  
17.02.2021 Bulletin 2021/07

(51) Int Cl.:  
**A61B 6/14 (2006.01)**      **A61B 6/00 (2006.01)**

(21) Application number: 19000371.5

(22) Date of filing: 12.08.2019

(84) Designated Contracting States:  
**AL AT BE BG CH CY CZ DE DK EE ES FI FR GB  
GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO  
PL PT RO RS SE SI SK SM TR**  
Designated Extension States:  
**BA ME**  
Designated Validation States:  
**KH MA MD TN**

(71) Applicants:  
• **DENTSPLY SIRONA Inc.**  
York, PA 17401 (US)

• **Sirona Dental Systems GmbH**  
**64625 Bensheim (DE)**

(72) Inventor: **Schulze-Ganzlin, Ulrich**  
**64653 Lorsch (DE)**

(74) Representative: **Özer, Alpdeniz**  
**Dentsply Sirona**  
**Legal IP Department**  
**Fabrikstraße 31**  
**64625 Bensheim (DE)**

### (54) MEASUREMENT AND DATA COMMUNICATION DEVICE FOR AN INTRAORAL DENTAL RADIOLOGY SYSTEM

(57) The present invention relates to a measurement and data communication device (10) for use in or with an intraoral dental radiology system (100) comprising: an x-ray data management unit (20) having a first communication means (21) for retrieving at least x-ray exposure data, and a processing means (22) for processing at least the retrieved data; an intraoral x-ray generation unit (30) having an x-ray source (31) for exposing at least part of a patient jaw with x-rays; and an intraoral x-ray acquisition unit (40) having a first x-ray sensor (41) for acquiring

x-ray image data of at least part of the patient jaw; said device (10) characterized by comprising: a measurement unit (11) for measuring features related to the x-rays used for exposing at least part of the patient, wherein the measurement unit (11) is arranged between the x-ray source (31) and the patient; and a second communication means (12) for transmitting the x-ray exposure data which includes the measured features to the x-ray data management unit (20).

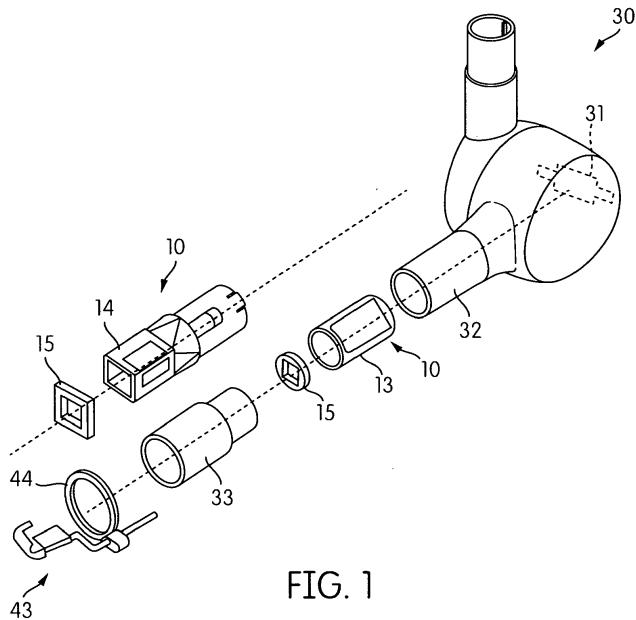


FIG. 1

**Description****TECHNICAL FIELD OF THE INVENTION**

**[0001]** The present invention relates to a radiology system. The present invention more particularly relates to an intraoral dental radiology system.

**BACKGROUND ART OF THE INVENTION**

**[0002]** In general, an intraoral dental radiology system comprises an intraoral x-ray generation unit, an intraoral x-ray acquisition unit, and an x-ray data management unit. The intraoral x-ray generation unit has an x-ray source for exposing at least part of a patient jaw with x-rays. The intraoral x-ray acquisition unit has an x-ray sensor for acquiring x-ray image data of at least part of the patient jaw. Different x-ray sensor technologies are available. The x-ray sensor might be a digital sensor or an analogue sensor such as a film or a phosphor plate. In general, a digital scanner is used to scan the analogue sensor and digitize the x-ray image. The x-ray sensor is usually held through a sensor holder which can be placed into the mouth of the patient. The sensor holder also has a ring for aligning the tube head of the x-ray generation unit with the x-ray sensor. The tube head includes the x-ray source. In the field of intraoral dental radiology, user-exchangeable collimators are optionally attached to the tube head of the intraoral X-ray generation unit for limiting the x-ray field. These collimators differ in the size of the usable x-ray field and are adapted to the size of the x-ray sensor. This avoids unnecessary exposure of the patient to x-rays that are not received by the x-ray sensor, and thereby reduces the patient dose. In the field of intraoral dental radiology, user-exchangeable additional extension tubes, e.g. from 20 cm (8 inches) to 30 cm (12 inches) are optionally attached to the tube head to extend the length of the tube head. With a larger source-sensor distance, the geometric aspects of the x-ray imaging can be improved, but in return the dose area product is reduced by a factor of the square of the distance.

**[0003]** For entry in the x-ray control book which is optionally used for quality management purposes, default values are used to determine the x-ray exposure data such as the duration of the x-ray exposure, the intensity of the x-ray field, the beam characteristics of the x-ray field, the type of the collimator, the type of the additional extension tube, the sensor-source distance/alignment, and the dose area product.

**[0004]** A problem with the prior art is that the default x-ray exposure data entered by the user may not always correspond the real x-ray exposure data because the intraoral dental radiology systems on the market do not recognize such x-ray exposure data directly.

**[0005]** US2006188065A1 discloses an intraoral dental radiology system according to prior art.

**DISCLOSURE OF THE INVENTION**

**[0006]** An objective of the present invention is to overcome the disadvantages of the prior art in an easy and cost-effective way and provide a measurement and data communication device for use in or with an intraoral dental radiology system.

**[0007]** This objective has been achieved through the measurement and data communication device as defined in claim 1, and the intraoral dental radiology system as defined in claim 12. The dependent claims relate to further developments.

**[0008]** The present invention provides a measurement and data communication device for use in or with an intraoral dental radiology system. The intraoral dental radiology system comprises: an x-ray data management unit having a communication means (hereinafter first communication means) for retrieving at least x-ray exposure data, and a processing means for processing at least the retrieved data; an intraoral x-ray generation unit having an x-ray source for exposing at least part of a patient jaw with x-rays; and an intraoral x-ray acquisition unit having an x-ray sensor (hereinafter first x-ray sensor) for acquiring x-ray image data of at least part of the patient jaw. The measurement and data communication device comprises: a measurement unit for measuring features related to the x-rays used for exposing at least part of the patient jaw, wherein the measurement unit is arranged between the x-ray source and the said at least part of the patient jaw; and a communication means (hereinafter second communication means) for transmitting the x-ray exposure data which includes the measured features to the x-ray data management unit.

**[0009]** A major advantageous effect of the present invention is that the x-ray exposure data can be correctly determined through the measurement, and easily transmitted to the x-ray data management unit through the measurement and communication device. Thereby, the intraoral dental radiology system can be more securely operated. Another major advantageous effect of the present invention is that an existing intraoral dental radiology system can be equipped with the measurement and communication device to benefit from these advantages.

**[0010]** According to an embodiment of the present invention, the intraoral x-ray generation unit preferably has a tube head which includes the x-ray source. And the measurement and communication device is preferably detachably attachable to the tube head. Thereby, an existing intraoral dental radiology system can be easily retrofitted with the measurement and communication device, and thus the x-ray exposure data can be generated and transmitted to the x-ray data management unit to keep a detailed log of the patient treatment and/or to control exposure of the patient.

**[0011]** According to an embodiment of the present invention, the measurement and communication device preferably has an insert tube as the housing which ac-

accommodates the measurement unit and the second communication means. And the insert tube can be detachably attached to the tube head without extending the length of the tube head. In this embodiment, the x-ray exposure data transmitted by the second communication means preferably includes information on the presence/absence or also the type of the insert tube.

**[0012]** According to an embodiment of the present invention, the intraoral x-ray generation unit preferably has an additional extension tube which is detachably attachable to the tube head to extend the length of the tube head. The above-mentioned insert tube is preferably usable with this additional extension tube. The additional extension tube is detachably attachable to the tube head in the state when the insert tube has already been attached to the tube head. In this embodiment, the measurement unit preferably has an extension tube identifier for identifying presence/absence or also type of the additional extension tube. In this embodiment, the exposure data which is transmitted by the second communication means preferably includes information on the presence/absence or also type of the additional extension tube i.e., the length of the additional extension tube. The extension tube identifier may have an electromechanical or optomechanical means for identifying a mechanical feature such as indents and/or projections or the like on the additional extension tube.

**[0013]** According to an alternative embodiment of the present invention, the measurement and communication device preferably comprises an extension tube as the housing instead of the insert tube. The extension tube accommodates the measurement unit and the second communication means. And the extension tube can be detachably attached to the tube head to extend the length of the tube head. Thereby, the source-sensor distance can be optionally increased, and the geometric aspects of the x-ray imaging can be further improved. In this alternative embodiment, the x-ray exposure data transmitted by the second communication means includes information on the presence/absence or also the type of the extension tube, i.e., the length of the extension tube.

**[0014]** According to an embodiment of the present invention, the measurement and communication device preferably has one or more user-exchangeable collimators for selectively limiting the x-ray field to the size of the first x-ray sensor. Thereby unnecessary exposure of the patient to x-rays not received by the x-ray sensor can be avoided or reduced as much as possible. The measurement unit preferably has a collimator identifier for identifying presence/absence or also type of the collimator. The type of the collimator is indicative of at least of its size. The diagonal of the collimator aperture is typically approx. 10 mm larger than the diagonal of the active area of the first x-ray sensor. In this embodiment, the exposure data transmitted by the second communication means includes information on the presence/absence or also type of the collimator. Thereby, the release of the x-ray exposure can be optionally inhibited if the collimator is

not suitable for the first x-ray sensor. The user may be informed on the false collimator through a warning signal. This warning signal might be generated through a user interface comprising an acoustic means or an optical means such as an LED or the like. To avoid unnecessarily loading of the tube head, the collimators are preferably very light (<200g). The measurement and communication device is also manufactured as light as possible to allow easy manipulation of the tube head which is arranged on a movable arm.

**[0015]** According to an embodiment of the present invention, the intraoral x-ray acquisition unit preferably has a sensor holder for holding the first x-ray sensor and a ring for positioning the tube head. The ring may also be used to align, the insert tube, the extension tube or the additional extension tube as mentioned above. The measurement and communication device is preferably rotatable around the center of the ring for facilitating the alignment. The ring may have a form fitting member for form-fittingly engaging with a counterpart form-fitting member on one of the tube head, the additional extension tube of the tube head, or the measurement and communication device. The form fitting-member may be round shaped or rectangular shaped. Other shapes may be alternatively used. The measurement unit preferably has a distance measurement means for measuring the distance of the x-ray source to the ring or to the patient. In this embodiment, the x-ray exposure data transmitted by the second communication means includes information on the measured distance. The distance measurement can be performed acoustically or optically with an ultrasound transceiver or infrared transceiver. The release of the x-ray exposure can be optionally inhibited if the distance is not suitable for the targeted region of the patient.

**[0016]** According to an embodiment of the present invention, the measurement unit preferably has a position and alignment measurement means for determining the position of the x-ray source and the alignment of the central beam of the x-ray field relative to a horizontal plane. In this embodiment, the x-ray exposure data transmitted by the second communication means includes information on the determined position and alignment. This allows to register the targeted region of the patient to be exposed to x-rays into a control book as left, middle or right part of the jaw as well as upper or lower part of the jaw. The release of the x-ray exposure can be optionally inhibited if the determined position or alignment is not suitable for the targeted region of the patient. The user may be informed on the misalignment by a warning signal through the user interface. The determination of the position and the alignment can be performed for instance through a Hall angle sensor, a gyroscope or compass sensor.

**[0017]** According to an embodiment of the present invention, the measurement and data communication device preferably has a separate power supplying means which has a motion sensor for activating the supply of power upon sensing motion. For instance, when the in-

sert tube / extension tube is attached to the tube head or moved together with the tube head for alignment, then the power supply may be activated. To save energy, the supply of power may be deactivated upon elapse of a predetermined duration or through the x-ray data management unit via the first communication means when the exposure is terminated. The device may also have a user control panel. The power supplying means may include a mains power cord or one or more batteries, preferably rechargeable batteries. These batteries can be recharged with an external charging unit without having to be removed from the measurement and data communication device. The energy transfer between the external charging unit and the batteries can be realized through flexible cables, electrical pin contacts and/or wireless means such as inductive means. The external charging unit may be portable or installable on a surface, preferably on the wall surface in a practice. The tube head can be relatively moved together with the measurement and communication device to the external charging unit.

**[0018]** According to an embodiment of the present invention, the measurement unit preferably has an x-ray sensor (hereinafter second x-ray sensor) for sensing the duration of the x-ray exposure, intensity of the x-rays, and/or the beam characteristics of the x-rays such as the x-ray tube voltage/current. In this embodiment, the exposure data transmitted by the second communication means preferably includes information on the duration of the x-ray exposure, the intensity of the x-rays, and/or the beam characteristics of the x-rays. The second x-ray sensor is arranged at a position where it does not obstruct x-rays exposing the targeted area of the patient.

**[0019]** The present invention also provides an intraoral dental radiology system which comprises: the intraoral x-ray generation unit having the x-ray source for exposing at least part of a patient jaw with x-rays; and the intraoral x-ray acquisition unit having the first x-ray sensor for acquiring x-ray image data of at least part of the patient jaw, the measurement and data communication device; and the x-ray data management unit which comprises: the first communication means adapted to retrieve the exposure data transmitted by the measurement and data communication device; and the processing means adapted to process the retrieved data.

**[0020]** According to an embodiment of the present invention, the first communication means of the x-ray data management unit preferably retrieves, in addition to the x-ray exposure data, the x-ray image data which is read from the first x-ray sensor. The intraoral x-ray acquisition unit has a communication means (hereinafter the third communication means) for transmitting the x-ray image data to the x-ray data management unit. If the first x-ray sensor is a digital sensor then the x-ray image data is read through a reading means, and transmitted. If the first x-ray sensor is an analogue sensor then the x-ray image is scanned and digitized through a digital scanning means and transmitted.

**[0021]** According to an embodiment of the present invention, the intraoral x-ray generation unit preferably has a communication means (hereinafter the fourth communication means). The processing means of the x-ray management unit is preferably further adapted to control the intraoral x-ray generation unit based on the x-ray exposure data via the fourth communication means. Thereby, the intraoral x-ray generation unit can be more securely operated. For instance, the processing means is preferably further adapted to control the exposure duration, the tube voltage and/or tube current of the x-ray source based on the x-ray exposure data. Thereby, the patient can be more securely handled. For instance, the processing means is preferably further adapted to inhibit release of the x-ray exposure by the intraoral x-ray generation unit if the identified collimator is not suitable for the first x-ray sensor, or the determined position and alignment of the tube head, or the measured distance of the patient is not suitable for the targeted region. In addition, the user may be acoustically and/or optically informed on such abnormalities.

**[0022]** According to an embodiment of the present invention, the x-ray data management unit is preferably adapted to evaluate the dose area product or any other information based on the x-ray exposure data.

**[0023]** According to an embodiment of the present invention, the x-ray data management unit preferably has a data storage means. The x-ray data management unit is preferably further adapted to record the acquired x-ray image data, the x-ray exposure data, patient information and/or other information evaluated based on the x-ray exposure data into the data storage means.

**[0024]** According to an embodiment of the present invention, the first to fourth communication means are preferably adapted for wireless communication. Alternatively, wired communication may be preferably used in any one of the first to fourth communication means. Alternatively, the communication between the first and the second communication means can be performed indirectly via either the third or the fourth communication means.

## BRIEF DESCRIPTION OF THE DRAWINGS

**[0025]** In the subsequent description, further aspects and advantageous effects of the present invention will be described in more detail by using exemplary embodiments and referring to the drawings, wherein

50 Fig. 1 - are schematic perspectives views of a first embodiment and a second embodiment of the measurement and data communication device each prior to attachment to the tube head of the intraoral dental radiology system;

55 Fig. 2 - is a schematic perspective view of the first embodiment of the measurement and data communication device of Fig. 1 after attachment to tube head of the intraoral dental radiology system;

Fig. 3 - is a schematic block view of the intraoral

dental radiology system retrofitted with the measurement and data communication device according to the first embodiment of the present invention; Fig. 4 - is a schematic block view of the intraoral dental radiology system retrofitted with the measurement and data communication device according to the second embodiment of the present invention.

**[0026]** The reference numbers shown in the drawings denote the elements as listed below and will be referred to in the subsequent description of the exemplary embodiments:

10. Measurement and data communication device
11. Measurement unit
- 11a. Extension tube identifier
- 11b. Collimator identifier
- 11c. Distance measurement means
- 11d. Position and alignment measurement means
- 11e. Second x-ray sensor
12. Second communication means
13. Insert tube
14. Extension tube
15. Collimator
16. Power supplying means
20. X-ray data management unit
21. First communication means
22. Processing means
23. Data storage means
30. Intraoral x-ray generation unit
31. X-ray source
32. Tube head
33. Additional extension tube
34. Fourth communication means
40. Intraoral x-ray acquisition unit
41. First x-ray sensor
42. Third communication means
43. Sensor holder
44. Ring
100. Intraoral dental radiology system

**[0027]** Fig. 3 illustrates a block diagram of an intraoral dental radiology system (100) according to a first embodiment. The intraoral dental radiology system (100) has a measurement and data communication device (10), an x-ray data management unit (20), an intraoral x-ray generation unit (30), and an intraoral x-ray acquisition unit (40). The measurement and data communication device (10) has a measurement unit (11) which is arranged between the intraoral x-ray generation unit (30) and the intraoral x-ray acquisition unit (40). The intraoral x-ray generation unit (30) has an x-ray source (31) for exposing at least part of a patient jaw with x-rays. The intraoral x-ray acquisition unit (40) has a first x-ray sensor (41) for acquiring x-ray image data of at least part of the patient jaw. The measurement unit (11) is specifically arranged between the x-ray source (31) and the patient. The measurement unit (11) is adapted to measure features related

to the x-rays used for exposing at least part of the patient. The x-ray data management unit (20) and the measurement and data communication device (10) have a first communication means (21) and a second communication means (12) respectively for mutual communication. The first communication means (21) and the second communication means (12) are adapted for wireless communication. The second communication means (12) is adapted to transmit x-ray exposure data which includes the measured features, to the x-ray data management unit (20). The first communication means (21) of the x-ray data management unit (20) is adapted to retrieve at least the x-ray exposure data. The x-ray data management unit (20) has a processing means (22) for processing at least the retrieved data such as the x-ray exposure data. The intraoral dental radiology (100) system is at least partly controlled by the processing means (22). The intraoral x-ray acquisition unit (40) has a third communication means (42) for transmitting the x-ray image data from the first x-ray sensor (41) to the x-ray data management unit (20). The first communication means (21) of the x-ray data management unit (20) is further adapted to retrieve the x-ray image data. The x-ray data management unit (20) has a data storage means (23) that is adapted to record, the retrieved x-ray image data, the x-ray exposure data, patient information and/or other information such as dose area products evaluated through the processing means (22) based on the x-ray exposure data. The intraoral x-ray generation unit (30) has a fourth communication means (34). The processing means (22) is further adapted to control the intraoral x-ray generation unit (30) based on the x-ray exposure data through the fourth communication means (34). The processing means (22) is further adapted to control the x-ray exposure duration, the x-ray tube voltage and/or x-ray tube current of the x-ray source (31) of the intraoral x-ray generation unit (30) based on the exposure data. The processing means (22) is further adapted to inhibit release of the x-ray exposure by the intraoral x-ray generation unit (30) if any abnormality through the x-ray exposure data is identified. Potential abnormalities will be explained later. Fig. 2 is a partial perspective view of the intraoral dental radiology system (100), especially of the intraoral x-ray generation unit (30) according to the first embodiment. The intraoral x-ray generation unit (30) is connectable from its upper part to a movable arm (not shown). The intraoral x-ray generation unit (30) has a tube head (32) which includes the x-ray source (31). The measurement and communication device (10) is detachably attachable to the tube head (32), preferably through complete insertion into the tube head (32). Fig. 2 illustrates the measurement and data communication device (10) after being attached to the tube head (32). Fig. 1 shows partial perspective views of the first embodiment, and also of an alternative second embodiment of the measurement and communication device (10) respectively arranged along the lower and upper dashed lines, which are both shown in the state detached from the tube

head (32). As shown in Fig. 1, the measurement and data communication device (10) according to the first embodiment has an insert tube (13) which accommodates the measurement unit (11) and the second communication means (12). As shown in Fig. 1 and Fig. 2, the insert tube (13) can be detachably attached, specifically inserted into the tube head (32) without extending the length of the tube head (32). The x-ray exposure data transmitted to the first communication means (21) includes information on the presence/absence or also the type of the insert tube (13). As shown in Fig. 1, the intraoral x-ray generation unit (30) according to the first embodiment has an additional extension tube (33) which is detachably attachable to the tube head (32) to extend the length of the tube head (32). The additional extension tube (33) is detachably attachable to the tube head (32) in the state when the insert tube (13) has been already attached to the tube head (32). Alternatively, the insert tube (13) can be attached to the additional extension tube (33), specifically through complete insertion into the large diameter portion of the additional extension tube (33) in the state when the additional extension tube (33) has been already attached to the tube head (32) through its low diameter portion. As shown in Fig. 3, the measurement unit (11) has an extension tube identifier (11a) for identifying presence/absence or also type of the additional extension tube (33). The x-ray exposure data transmitted to the first communication means (21) includes information on the presence/absence or also type of the additional extension tube (33). As shown in Fig. 1, the measurement and data communication device (10) according to the first embodiment has a user-exchangeable collimator (15) for limiting the x-ray field to the size of the first x-ray sensor (41). As shown in Fig. 3, the measurement unit (11) has a collimator identifier (11b) for identifying presence/absence or also type of the collimator (15). The type of the collimator (15) is indicative of at least its size. The processing means (22) is further adapted to inhibit release of x-ray exposure by the intraoral x-ray generation unit (30) if the identified collimator (15) is not suitable for the first x-ray sensor (41). The x-ray exposure data transmitted to the first communication means (21) includes information on the presence/absence or also type of the collimator (15). Thereby, the x-ray exposure data includes the previously mentioned abnormality relating to the collimators (15). As shown in Fig. 1, the intraoral x-ray acquisition unit (40) has a sensor holder (43) for holding the first x-ray sensor (41), and a ring (44) for positioning the tube head (32). As shown in Fig. 3, the measurement unit (11) has a distance measurement means, (11c) for measuring the distance of the x-ray source (31) to the ring (44) or to the patient. The exposure data transmitted to the first communication means (21) includes information on the measured distance. The release of the x-ray exposure can be optionally inhibited if the distance is not suitable for the targeted region of the patient. As shown in Fig. 3, the measurement unit (11) comprises a position and alignment measurement means (11d) for

determining the position of the x-ray source (31) and the alignment of the central beam of the x-ray field relative to a horizontal plane. The alignment comprises the azimuthal angle and the polar angle. The x-ray exposure data transmitted to the first communication means (21) includes information on the determined position and alignment. The processing means (22) is adapted to inhibit release of x-ray exposure by the intraoral x-ray generation unit (30) if the determined position and alignment is not suitable for the targeted region. Thereby, the x-ray exposure data includes the previously mentioned abnormality relating to the position and alignment. As shown in Fig. 3, the measurement and data communication device (10) has a power supplying means (16) which has a motion sensor for activating the supply of power upon sensing any motion. As shown in Fig. 3, the measurement unit (11) has a second x-ray sensor (11e) for measuring the duration of the x-ray exposure, intensity of the x-rays, and/or the beam characteristics of the x-rays. The x-ray exposure data transmitted to the first communication means (21) includes information on the duration of the x-ray exposure, the intensity of the x-rays, and/or the beam characteristics of the x-rays. It is also conceivable that the communication between the first communication means (21) and the second communication means (12) for transmitting the x-ray exposure data may also be realized indirectly via the third communication means (42) and/or the fourth communication means (34).

**[0028]** Fig. 4 illustrates a block diagram of an intraoral dental radiology system (100) according to the second embodiment. The intraoral dental radiology system (100) of Fig. 4 differs from that of Fig. 3 only in that the measurement and communications device (10) has alternatively an extension tube (14) instead of the insert tube (13). Similar to the first embodiment, the extension tube (14) also accommodates the measurement unit (11) and the second communication means (12). The extension tube (14) can be detachably attached to the tube head (32) to extend the length of the tube head (32). The extension tube (14) may also be detachably attached to the tube head (32) via the additional extension tube (33). The collimators (15) used with the extension tube (14) is preferably rectangular shaped. Alternatively, round shaped collimators (15) may be used. The forward end of the extension tube (14) is rectangular shape. Alternatively, it may have a round shape as the insert tube (13). The x-ray exposure data transmitted to the first communication means (21) includes information on the presence/absence or also the type of the extension tube (14).

50

## Claims

1. A measurement and data communication device (10) for use in or with an intraoral dental radiology system (100) comprising:

an x-ray data management unit (20) having a

first communication means (21) for retrieving at least x-ray exposure data, and a processing means (22) for processing at least the retrieved data;

an intraoral x-ray generation unit (30) having an x-ray source (31) for exposing at least part of a patient jaw with x-rays; and

an intraoral x-ray acquisition unit (40) having a first x-ray sensor (41) for acquiring x-ray image data of at least part of the patient jaw;  
said device (10) **characterized by** comprising:

a measurement unit (11) for measuring features related to the x-rays used for exposing at least part of the patient, wherein the measurement unit (11) is arranged between the x-ray source (31) and the patient; and a second communication means (12) for transmitting the x-ray exposure data which includes the measured features to the x-ray data management unit (20).

2. The measurement and data communication device (10) according to claim 1, wherein the intraoral x-ray generation unit (30) has a tube head (32) which includes the x-ray source (31), the device (10) being **characterized in that** it is detachably attachable to the tube head (32).

3. The measurement and data communication device (10) according to claim 2, **characterized in that** the device (10) has an extension tube (14) which includes the measurement unit (11) and the second communication means (12), wherein the extension tube (14) can be detachably attached to the tube head (32) to extend the length of the tube head (32), wherein the x-ray exposure data further includes information on the presence/absence or also the type of the extension tube (14).

4. The measurement and data communication device (10) according to claim 2, **characterized in that** the device (10) has an insert tube (13) which includes the measurement unit (11) and the second communication means (12), wherein the insert tube (13) can be detachably attached to the tube head (32) without extending the length of the tube head (32), wherein the x-ray exposure data further includes information on the presence/absence or also the type of the insert tube (13).

5. The measurement and data communication device (10) according to claim 3 or 4, wherein the intraoral x-ray generation unit (30) has an additional extension tube (33) which is detachably attachable to the tube head (32) to extend the length of the tube head (32), the device (10) being **characterized in that** the additional extension tube (33) is detachably attach-

able to the tube head (32) in the state when the insert tube (13) or the extension tube (14) is also attached to the tube head (32).

5 6. The measurement and data communication device (10) according to claim 5, **characterized in that** the measurement unit (11) has an extension tube identifier (11a) for identifying presence/absence or also type of the additional extension tube (33), wherein the x-ray exposure data further includes information on the presence/absence or also type of the additional extension tube (33).

7. The measurement and data communication device (10) according to any one of claims 1 to 6, **characterized by** further comprising: a user-exchangeable collimator (15) for limiting the x-ray field to the size of the first x-ray sensor (41); and the measurement unit (11) comprises a collimator identifier (11b) for identifying presence/absence or also type of the collimator (15), wherein the type of the collimator (15) is indicative of at least its size, wherein the x-ray exposure data further includes information on the presence/absence or also type of the collimator (15).

25 8. The measurement and data communication device (10) according to any one of claims 1 to 7, wherein the intraoral x-ray acquisition unit (40) has a sensor holder (43) for holding the first x-ray sensor (41) and a ring (44) for positioning the tube head (32), **characterized in that** the measurement unit (11) comprises a distance measurement means (11c) for measuring the distance of the x-ray source (31) to the ring (44) or to the patient, wherein the x-ray exposure data further includes information on the measured distance.

30 9. The measurement and data communication device (10) according to any one of claims 1 to 8, **characterized in that** the measurement unit (11) comprises a position and alignment measurement means (11d) for determining the position of the x-ray source (31) and the alignment of the central beam of the x-ray field relative to a horizontal plane, wherein the x-ray exposure data further includes information on the determined position and alignment.

40 10. The measurement and data communication device (10) according to any one of claims 1 to 9, **characterized by** further comprising a power supplying means (16) which has a motion sensor for activating the supply of power upon sensing motion.

45 55 11. The measurement and data communication device (10) according to any one of claims 1 to 10, **characterized in that** the measurement unit (11) comprises a second x-ray sensor (11e) for measuring the duration of the x-ray exposure, intensity of the x-rays,

and/or the beam characteristics of the x-rays, where-  
in the x-ray exposure data further includes informa-  
tion on the duration of the x-ray exposure, the inten-  
sity of the x-rays, and/or the beam characteristics of  
the x-rays. 5

12. An intraoral dental radiology system (100) compris-  
ing:  
  
an intraoral x-ray generation unit (30) having an  
x-ray source (31) for exposing at least part of a  
patient jaw with x-rays; and  
an intraoral x-ray acquisition unit (40) having an  
first x-ray sensor (41) for acquiring x-ray image  
data of at least part of the patient jaw,  
**characterized by** further comprising:  
  
the measurement and data communication  
device (10) according to any one of claims  
1 to 11;  
an x-ray data management unit (20) which  
comprises: a first communication means  
(21) adapted to retrieve the x-ray exposure  
data transmitted by the measurement and  
data communication device (10); and a  
processing means (22) adapted to process  
the retrieved data. 15

13. The intraoral dental radiology system (100) accord-  
ing to claim 12, **characterized in that** the first com-  
munication means (21) and the second communica-  
tion means (12) are adapted for wireless communi-  
cation. 20

14. The intraoral dental radiology system (100) accord-  
ing to claim 12 or 13, **characterized in that** the first  
communication means (21) of the x-ray data man-  
agement unit (20) is further adapted to retrieve the  
x-ray image data, and the intraoral x-ray acquisition  
unit (40) has a third communication means (42) for  
transmitting the x-ray image data to the x-ray data  
management unit (20). 25

15. The intraoral dental radiology system (100) accord-  
ing to any one of claims 12 to 14, **characterized in**  
**that** the intraoral x-ray generation unit (30) has a  
fourth communication means (34), and the process-  
ing means (22) is further adapted to control the  
intraoral x-ray generation unit (30) based on the x-ray  
exposure data. 30

16. The intraoral dental radiology system (100) accord-  
ing to claim 15, **characterized in that** the processing  
means (22) is further adapted to control x-ray expo-  
sure duration, the tube voltage and/or the tube cur-  
rent of the x-ray source (31) of the intraoral x-ray  
generation unit (30) based on the x-ray exposure  
data. 35

17. The intraoral dental radiology system (100) accord-  
ing to claim 15 or 16, **characterized in that** the  
processing means (22) is further adapted to inhibit  
release of x-ray exposure by the intraoral x-ray gen-  
eration unit (30) if the identified collimator (15) is not  
suitable for first x-ray sensor (41), or the determined  
position and alignment, or the measured distance is  
not suitable for the targeted region. 40

18. The intraoral dental radiology system (100) accord-  
ing to any one of claims 12 to 17, **characterized in**  
**that** the processing means (22) is further adapted  
to evaluate the dose area product based on the x-  
ray exposure data. 45

19. The intraoral dental radiology system (100) accord-  
ing to any one of claims 12 to 18, **characterized in**  
**that** the x-ray data management unit (20) comprises  
a data storage means (23) adapted to record the  
acquired x-ray image data, the x-ray exposure data,  
patient information and/or other information evaluat-  
ed based on the x-ray exposure data. 50

FIG. 2

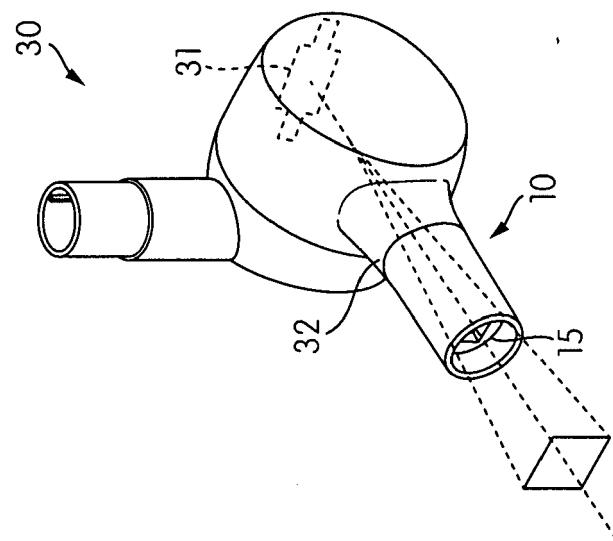
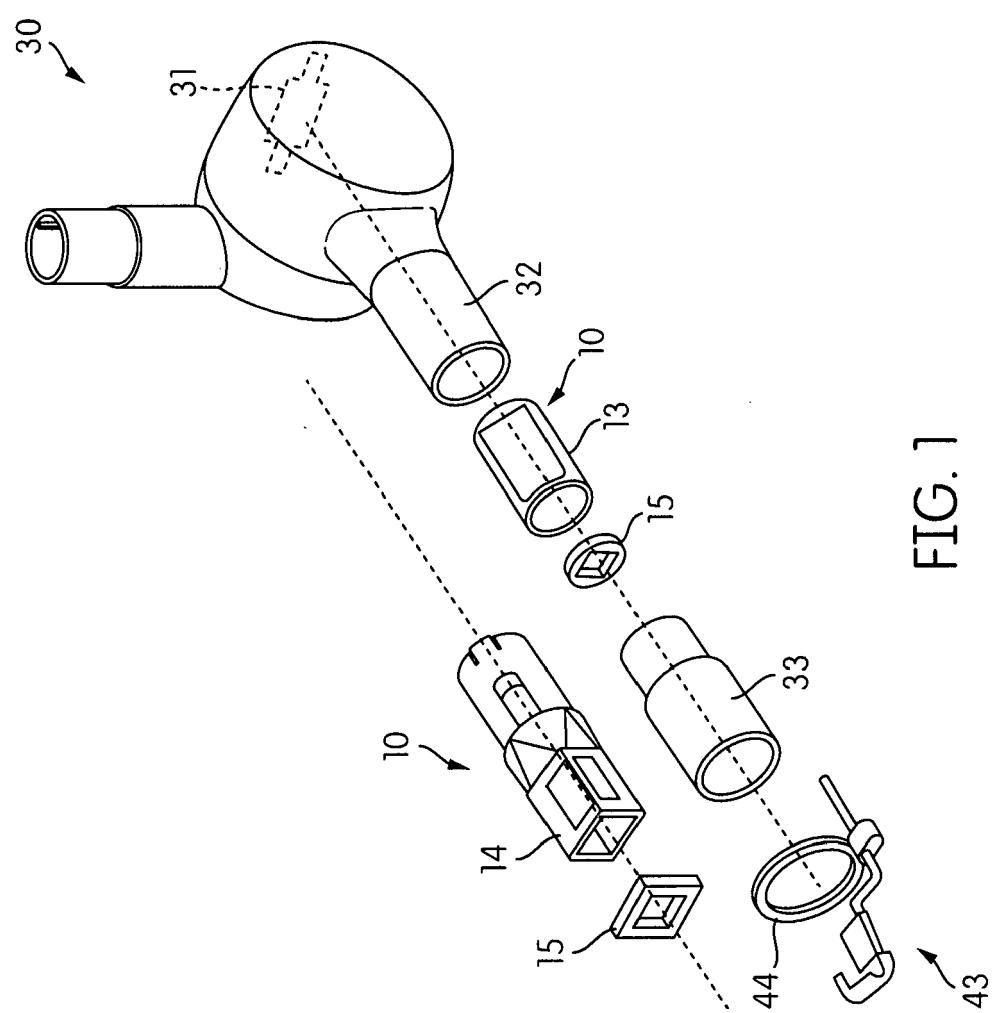


FIG. 1



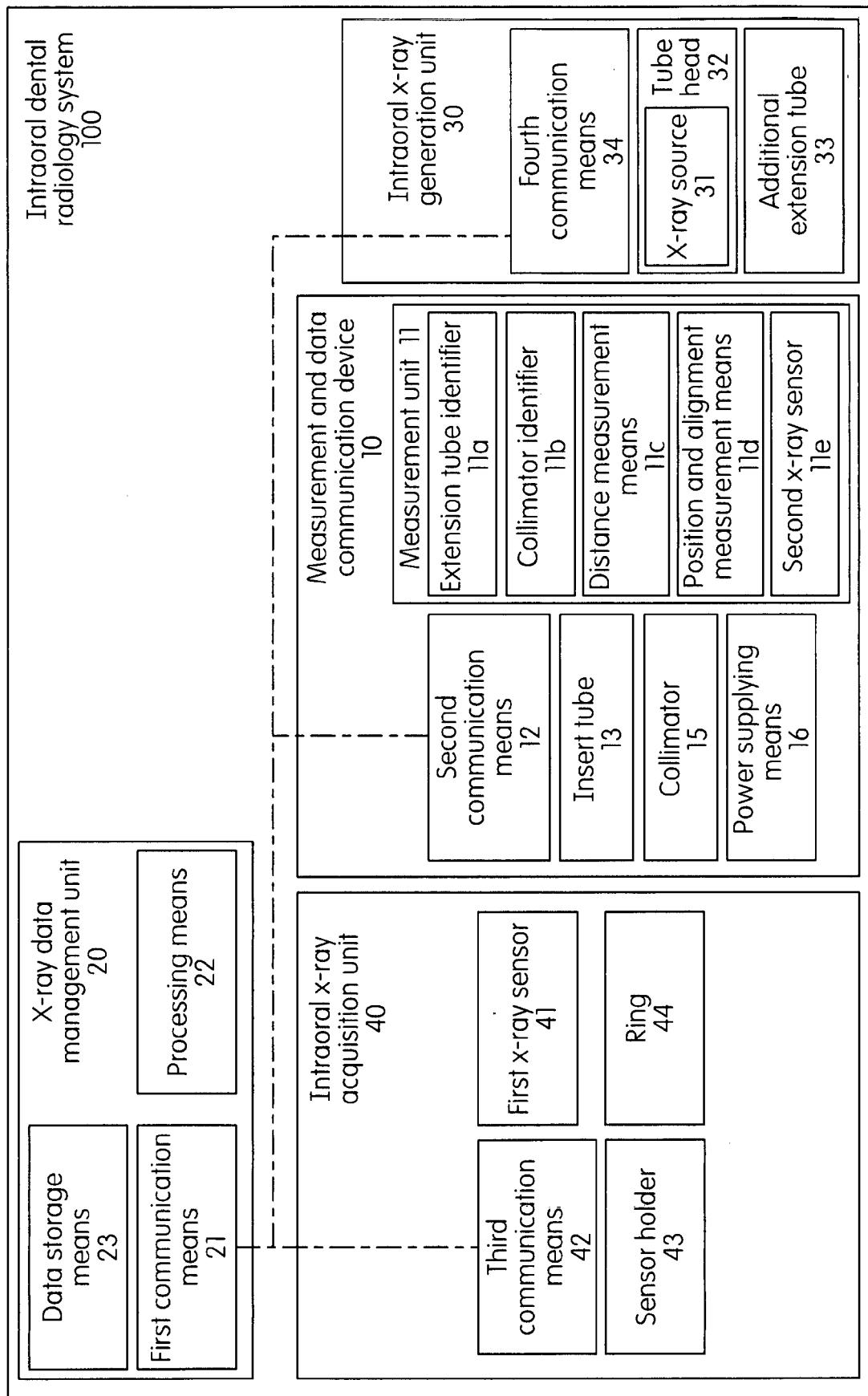


FIG. 3

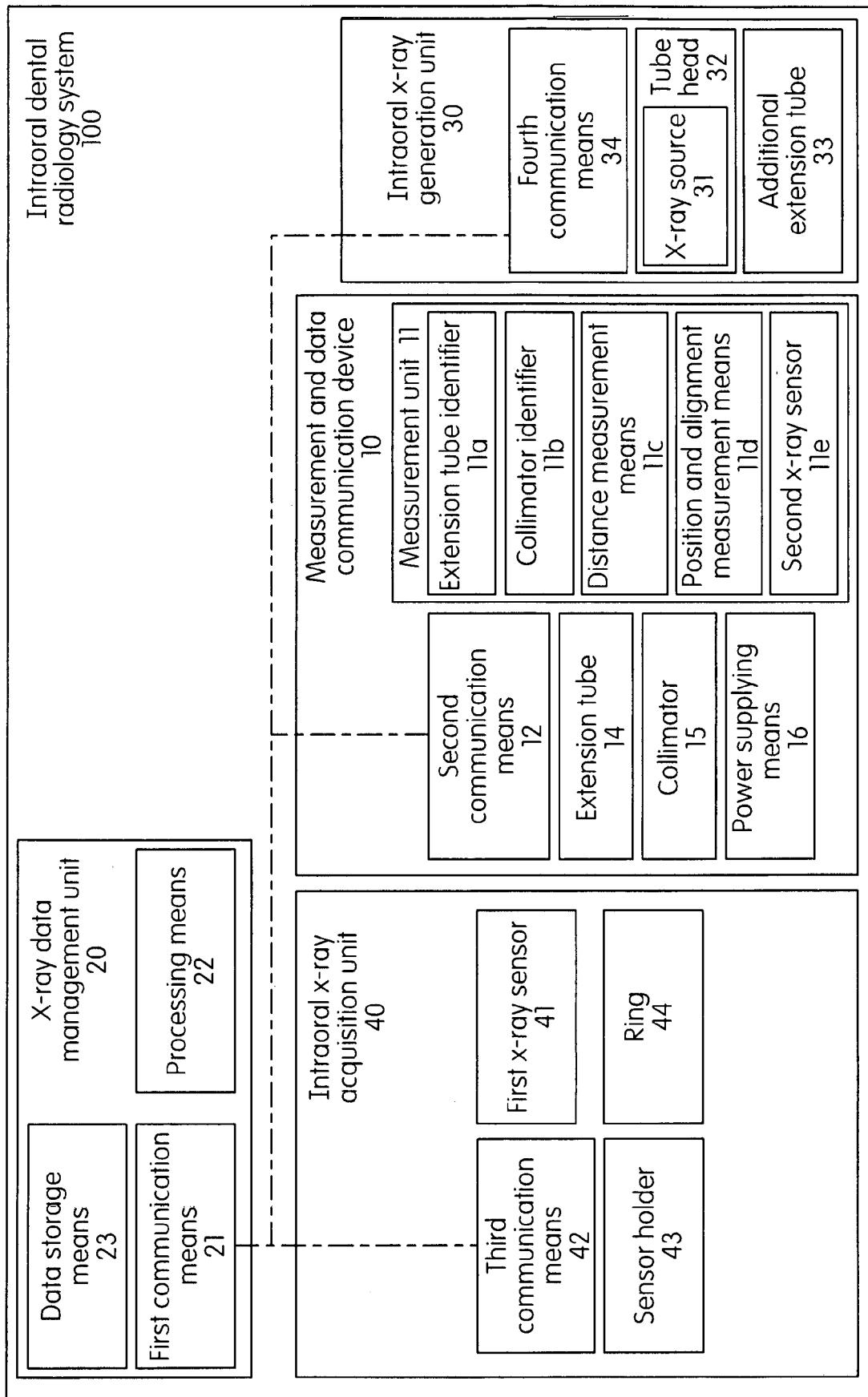


FIG. 4



## EUROPEAN SEARCH REPORT

Application Number

EP 19 00 0371

5

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
10 A,D	US 2006/188065 A1 (RAZZANO MICHAEL R [US] ET AL) 24 August 2006 (2006-08-24) * paragraph [0034] - paragraph [0092] *	1-19	INV. A61B6/14 A61B6/00
15 A	DE 10 2007 033957 A1 (SIRONA DENTAL SYSTEMS GMBH [DE]) 22 January 2009 (2009-01-22) * paragraph [0036] - paragraph [0051] *	1-19	
20 A	US 2017/188987 A1 (LIU XINQIAO [US] ET AL) 6 July 2017 (2017-07-06) * paragraph [0018] - paragraph [0027] *	1-19	
25 A	US 2016/262715 A1 (CHARNEGIE JEREMY [US] ET AL) 15 September 2016 (2016-09-15) * paragraph [0033] - paragraph [0073] *	1-19	
30			TECHNICAL FIELDS SEARCHED (IPC)
35			A61B
40			
45			
50 1 EPO FORM 1503 03-82 (P04C01)	The present search report has been drawn up for all claims		
55	Place of search Munich	Date of completion of the search 29 January 2020	Examiner Hooper, Martin
CATEGORY OF CITED DOCUMENTS		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons ..... & : member of the same patent family, corresponding document	
X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document			

ANNEX TO THE EUROPEAN SEARCH REPORT  
ON EUROPEAN PATENT APPLICATION NO.

EP 19 00 0371

5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

29-01-2020

10	Patent document cited in search report	Publication date		Patent family member(s)	Publication date
15	US 2006188065 A1	24-08-2006	CA EP US US US WO	2598681 A1 1853168 A2 2006188064 A1 2006188065 A1 2006188070 A1 2006091712 A2	31-08-2006 14-11-2007 24-08-2006 24-08-2006 24-08-2006 31-08-2006
20	DE 102007033957 A1	22-01-2009		NONE	
25	US 2017188987 A1	06-07-2017	CA CN GB US WO	3013358 A1 108770337 A 2564599 A 2017188987 A1 2017120621 A1	13-07-2017 06-11-2018 16-01-2019 06-07-2017 13-07-2017
30	US 2016262715 A1	15-09-2016		NONE	
35					
40					
45					
50					
55					

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

**REFERENCES CITED IN THE DESCRIPTION**

*This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.*

**Patent documents cited in the description**

- US 2006188065 A1 [0005]